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Applicant(s): CANON KABUSHIKI KAISHA

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[Title of the Invention]	Multi-beam scanning apparatus
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[Inventor]	
[Domicile or Residence]	c/o Canon Kabushiki Kaisha 30-2, 3-chome, Shimomaruko, Ohta-ku, Tokyo
[Name]	SHIN MOGI
[Applicant]	
[Identification No.]	000001007
[Name]	CANON KABUSHIKI KAISHA
[Representative]	FUJIO MITARAI
[Patent Attorney]	
[Identification No.]	100095991
[Attorney]	YOSHIRO SAKAMOTO
[Telephone]	03-5685-6311
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[List of Filed Materials]

[Material]	Specification	01
[Material]	Drawings	01
[Material]	Abstract	01

[Name of the Document] Specification

[Title of the Invention] Multi-beam scanning apparatus

[What is claimed is]

[Claim 1]

A multi-beam scanning apparatus comprising:

a multi-beam light source unit having a multi-beam semiconductor laser and a laser holder for holding said multi-beam semiconductor laser;

scanning imaging means for scanning a plurality of laser beams emitted by said multi-beam semiconductor laser to focus on a photosensitive body; and

a housing supporting said scanning imaging means and said multi-beam light source unit,

wherein said multi-beam semiconductor laser is fixed to said laser holder at or near a predetermined rotational angle for adjusting a beam interval between said plurality of laser beams.

[Claim 2]

An apparatus according to claim 1, wherein said multi-beam semiconductor laser has a plurality of aligned emission points.

[Claim 3]

An apparatus according to claim 1, wherein said multi-beam semiconductor laser has a plurality of two-dimensionally arrayed emission points.

[Claim 4]

An apparatus according to any of claims 1 through 3,

wherein said laser holder is integrated with a lens barrel holding a collimator lens.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a multi-beam scanning apparatus used for a laser beam printer, digital copying machine, and the like.

[0002]

[Prior Art]

In recent years, multi-beam scanning apparatuses for simultaneously writing a plurality of lines using a plurality of laser beams are being developed in electrophotographic apparatuses such as a laser beam printer.

[0003]

The multi-beam scanning apparatus simultaneously scans a plurality of laser beams apart from each other. As shown in Fig. 9, in the multi-beam scanning apparatus, a multi-beam semiconductor laser 111 serving as a light source for a multi-beam light source unit 101 emits two laser beams P_1 and P_2. The laser beams P_1 and P_2 are collimated by a collimator lens 112, irradiate a reflecting surface 103a of a rotary polygon mirror 103 via a cylindrical lens 102, and form an image on a photosensitive member on a rotary drum 105 via an imaging lens 104.

[0004]

The two laser beams P_1 and P_2 are incident on the

reflecting surface 103a of the rotary polygon mirror 103, scanned in the main scanning direction, and form an electrostatic latent image on the photosensitive member along with main scanning by rotation of the rotary polygon mirror 103 and subscanning by rotation of the rotary drum 105.

[0005]

The cylindrical lens 102 linearly focuses the laser beams P_1 and P_2 on the reflecting surface 103a of the rotary polygon mirror 103. The cylindrical lens 102 has a function of preventing a point image formed on the photosensitive member in the above manner from being distorted due to surface tilt of the rotary polygon mirror 103. The imaging lens 104 is made up of a spherical lens and toric lens. The imaging lens 104 has a function of preventing distortion of a point image on the photosensitive member, similar to the cylindrical lens 102, and a correction function of scanning the point image on the photosensitive member in the main scanning direction at a constant speed.

[0006]

The two laser beams P_1 and P_2 are respectively split by a detection mirror 106 at the end of the main scanning plane (X-Y plane), guided to a photosensor 107 on an opposite side to the main scanning plane, and converted into write start signals in a controller (not shown) to be transmitted to the multi-beam semiconductor laser 111. The multi-beam semiconductor laser 111 receives the write start signals

to start write modulation of the two laser beams P_1 and P_2.

[0007]

By adjusting the write modulation timings of the two laser beams P_1 and P_2, the write start (write) position of an electrostatic latent image formed on the photosensitive member on the rotary drum 105 is controlled.

[0008]

The cylindrical lens 102, rotary polygon mirror 103, imaging lens 104, and the like are mounted on the bottom wall of an optical box 108. After the respective optical components are mounted in the optical box 108, the upper opening of the optical box 108 is closed with a lid (not shown).

[0009]

As described above, the multi-beam semiconductor laser 111 simultaneously emits the laser beams P_1 and P_2. The multi-beam semiconductor laser 111 is integrated via a laser holder 111a with a lens barrel 112a incorporating the collimator lens 112, and the integral unit is mounted on a sidewall 108a of the optical box 108 together with a laser driving circuit board 113.

[0010]

In mounting the multi-beam light source unit 101, the laser holder 111a holding the multi-beam semiconductor laser 111 is inserted into an opening 108b formed in the sidewall 108a of the optical box 108. The laser holder 111a is fitted

in the lens barrel 112a of the collimator lens 112, the focal point and optical axis of the collimator lens 112 are adjusted, and the lens barrel 112a is adhered to the laser holder 111a. As shown in Fig. 10(a), the laser holder 111a is rotated through a predetermined angle è to adjust a straight line connecting the emission points of the laser beams P_1 and P_2, i.e., the inclination angle of a laser array N. More specifically, as shown in Fig. 10(b), the beam interval between the laser beams P_1 and P_2 emitted by the multi-beam semiconductor laser 111 is adjusted to make a pitch S between imaging points A_1 and A_2 on the rotary drum 105 in the main scanning direction, and a pitch, i.e., line interval T in the subscanning direction coincide with design values. After this adjustment, the laser holder 111a is fixed to the sidewall 108a of the optical box 108 with a screw or the like.

[0011]

[Problems to be solved by the Invention]

In the prior art, however, when the multi-beam light source unit is to be fixed to the optical box, the whole multi-beam light source unit is rotated through the predetermined angle è together with the laser driving circuit board, thereby obtaining the line interval T. To realize this, a space enough to rotate the large-area laser driving circuit board must be prepared outside the optical box, which interferes with downsizing of the whole apparatus.

[0012]

Further, an error allowable value for adjustment of the line interval T is as strict as several im or less. If the angular adjustment range in assembling the multi-beam light source unit to the optical box is wide, high-precision adjustment is difficult to complete within a short time. The multi-beam light source unit cannot be assembled with high working efficiency and high reliability.

[0013]

The present invention has been made to eliminate the conventional drawbacks, and has as its object to provide a multi-beam scanning apparatus which can be downsized and allows adjusting the beam interval within a short time with high precision.

[0014]

[Means for solving the Problems]

To achieve the above object, according to the present invention, there is provided a multi-beam scanning apparatus comprising a multi-beam light source unit having a multi-beam semiconductor laser and a laser holder holding the multi-beam semiconductor laser, scanning imaging means for scanning a plurality of laser beams emitted by the multi-beam semiconductor laser to focus on a photosensitive body, and a housing supporting the scanning imaging means and the multi-beam light source unit, wherein the multi-beam semiconductor laser is fixed to the laser holder at or near a predetermined rotational angle for adjusting a beam interval between the plurality of laser beams.

[0015]

The multi-beam semiconductor laser preferably has a plurality of aligned emission points.

[0016]

The multi-beam semiconductor laser preferably has a plurality of two-dimensionally arrayed emission points.

[0017]

The laser holder is preferably integrated with a lens barrel holding a collimator lens.

[0018]

[Function]

In mounting the laser holder in the housing after the multi-beam semiconductor laser is fixed to the laser holder, the whole multi-beam light source unit is inclined (rotated) to adjust the beam interval. In this arrangement, however, angular adjustment is difficult to perform precisely, and spends a long time. In addition, an extra space is required to incline the large-area laser driving circuit board mounted on the multi-beam light source unit. To avoid this, in a unit assembly step of assembling the multi-beam semiconductor laser to the laser holder, the multi-beam semiconductor laser is rotated (inclined) through an angle necessary for adjusting the beam interval or an angle approximate to the necessary angle. In this state, the multi-beam semiconductor laser is fixed to the laser holder into a unit.

[0019]

In mounting the multi-beam light source unit in the housing, the whole multi-beam light source unit is rotated through a small angle in order to finally adjust a small error arising from the component precision and the like.

[0020]

Since final angular adjustment in mounting the multi-beam light source unit in the housing is done within a small angular range, the angle can be quickly adjusted with high precision.

[0021]

Since the large-area laser driving circuit board need not be greatly inclined, the whole apparatus can be downsized.

[0022]

[Embodiments of the Invention]

Embodiments of the present invention will be described below with reference to the accompanying drawings.

[0023]

Fig. 1 shows a multi-beam scanning apparatus of an embodiment. In this multi-beam scanning apparatus, a multi-beam semiconductor laser 11 serving as a light source for a multi-beam light source unit 1 emits two laser beams P_1 and P_2. The laser beams P_1 and P_2 are collimated by a collimator lens 12, irradiate a reflecting surface 3a of a rotary polygon mirror 3 via a cylindrical lens 2, and form an image on a photosensitive member on a rotary drum 5 via an imaging lens 4 which constitutes a scanning imaging means together with the rotary polygon mirror 3.

[0024]

The two laser beams P_1 and P_2 are incident on the reflecting surface 3a of the rotary polygon mirror 3, scanned in the main scanning direction, and form an electrostatic latent image on the photosensitive member along with main scanning by rotation of the rotary polygon mirror 3 and subscanning by rotation of the rotary drum 5.

[0025]

The cylindrical lens 2 linearly focuses the laser beams P_1 and P_2 on the reflecting surface 3a of the rotary polygon mirror 3. The cylindrical lens 2 has a function of preventing a point image formed on the photosensitive member in the above manner from being distorted due to surface tilt of the rotary polygon mirror 3. The imaging lens 4 is made up of a spherical lens and toric lens. The imaging lens 4 has a function of preventing distortion of a point image on the photosensitive member, similar to the cylindrical lens 2, and a correction function of scanning the point image on the photosensitive member in the main scanning direction at a constant speed.

[0026]

The two laser beams P_1 and P_2 are respectively split by a detection mirror 6 at the end of the main scanning plane (X-Y plane), guided to a photosensor 7 on an opposite side to the main scanning plane, and converted into write start signals in a controller (not shown) to be transmitted to the multi-beam semiconductor laser 11. The multi-beam

semiconductor laser 11 receives the write start signals to start write modulation of the two laser beams P_1 and P_2.

[0027]

By adjusting the write modulation timings of the two laser beams P_1 and P_2, the write start (write) position of an electrostatic latent image formed on the photosensitive member on the rotary drum 5 is controlled.

[0028]

The cylindrical lens 2, rotary polygon mirror 3, imaging lens 4, and the like are mounted on the bottom wall of an optical box 8 serving as a housing. After the respective optical components are mounted in the optical box 8, the upper opening of the optical box 8 is closed with a lid (not shown).

[0029]

As described above, the multi-beam semiconductor laser 11 simultaneously emits the laser beams P_1 and P_2. The multi-beam semiconductor laser 11 is integrated via a laser holder 11a with a lens barrel 12a incorporating the collimator lens 12, and the integral unit is mounted on a sidewall 8a of the optical box 8 together with a laser driving circuit board 13.

[0030]

In mounting the multi-beam light source unit 1, the laser holder 11a holding the multi-beam semiconductor laser 11 is inserted into an opening 8b formed in the sidewall

8a of the optical box 8. The laser holder 11a is fitted in the lens barrel 12a of the collimator lens 12, three-dimensional adjustment such as focus adjustment and optical axis adjustment of the collimator lens 12 is done, and the lens barrel 12a is adhered to the laser holder 11a.

[0031]

As shown in Fig. 2, the multi-beam semiconductor laser 11 comprises a laser chip 22 fixed to a pedestal 21a integrated with a stem 21, a photodiode 23 for monitoring the emission amounts of laser beams P_1 and P_2 emitted from two emission points 22a and 22b on the laser chip 22, and an enerigization terminal 24 for energizing the laser chip 22 and the like. The laser chip 22 and the like are covered with a cap 25.

[0032]

In a unit assembly step of mounting the multi-beam semiconductor laser 11 in the laser holder 11a, the multi-beam semiconductor laser 11 is rotated through a predetermined rotational angle è or angle approximate to the angle è with respect to a reference surface V of the laser holder 11a, as shown in Fig. 3, thereby adjusting in advance the inclination angle of a straight line, i.e., laser array N connecting the emission points of the laser beams P_1 and P_2. More specifically, the beam interval between the laser beams P_1 and P_2 emitted by the multi-beam semiconductor laser 11 is adjusted to make a pitch S between imaging points A_1 and A_2 on the rotary drum 5 in the main scanning direction, and a pitch, i.e., line interval T in the subscanning direction

coincide with design values in advance (see Fig. 3(b)). After this adjustment, the multi-beam semiconductor laser 11 is fixed to the laser holder 11a to obtain a unit.

[0033]

After the lens barrel 12a of the collimator lens 12 is adhered to the laser holder 11a, as described above, the laser holder 11a is temporarily fixed to the sidewall 8a of the optical box 8 with screws 11b fitted in slots of the laser holder 11a, as shown in Fig. 4. While emitting the laser beams P_1 and P_2, the laser holder 11a is rotated through a small angle Äè for final adjustment of the line interval T in order to compensate for the precision of each apparatus component and an error at the fit portion of the multi-beam semiconductor laser 11 itself. In practice, as indicated by the broken line in Fig. 5, this adjustment is done after the laser driving circuit board 13 is mounted on the laser holder 11a. Upon the final adjustment, the screws 11b are tightened to fix the laser holder 11a to the optical box 8.

[0034]

The line interval T on the rotary drum must be adjusted with submicron-order precision. In the present embodiment, when the multi-beam semiconductor laser is mounted in the laser holder, the laser array N is roughly adjusted to or near to the predetermined inclination angle è. When the laser holder is mounted in the optical box together with the laser driving circuit board, the angle is finally slightly

adjusted to correct an assembly error and the like. Therefore, the final line interval adjustment precision is very high, and the adjustment time can be greatly shortened compared to the conventional wide-range angular adjustment on the optical box. In addition, the large-area laser driving circuit board need not be rotated outside the optical box, and the apparatus can be downsized.

[0035]

As a result, this embodiment can realize a small-size, high-precision multi-beam scanning apparatus with low assembly cost.

[0036]

Note that this embodiment uses the laser chip with two emission points. However, the number of emission points, i.e., laser beams can be arbitrarily changed. The assembly procedure of the laser driving circuit board, lens barrel, collimator lens, and the like can also be arbitrarily changed. The laser holder can be fixed to the optical box not only with a fastening means such as a screw, but also by another method such as adhesion.

[0037]

Fig. 6 shows a variation. This multi-beam light source unit uses a disk-like laser holder 31a instead of the rectangular laser holder 11a having a reference surface V as an end face. In this case, a reference surface U with a rotational angle è in mounting a multi-beam semiconductor laser 31 in the laser holder 31a is defined at a notched

portion 31b at the circumferential portion of the laser holder 31a.

[0038]

As shown in Fig. 7, a laser driving circuit board 33 is mounted on the laser holder 31a such that an upper end face 33a serves as an attachment reference for an optical box (not shown).

[0039]

The edge emission type multi-beam semiconductor lasers 11 and 31 on each of which a plurality of emission points are aligned may be replaced with a multi-beam semiconductor laser 41 having a surface emission type laser chip 42 on which a plurality of emission points 42a to 42d are two-dimensionally arrayed, as shown in Fig. 8. This multi-beam semiconductor laser 41 can advantageously reduce optical aberration because all the emission points can be made close to the optical axis of the collimator lens. A positioning hole 41b is formed in a disk-like laser holder 41a as a positioning reference used to adjust the rotational angle è for adjusting beam intervals T_1 to T_3.

[0040]

The surface emission type laser can increase the degree of freedom for the positions of the emission points to facilitate distribution of the mounting tolerance.

[0041]

[Effect of the Invention]

With this arrangement, the present invention exhibits

the following effects.

[0042]

The beam interval between a plurality of laser beams emitted by the multi-beam semiconductor laser can be adjusted within a short time with high precision. Accordingly, the apparatus can attain high resolution, the assembly cost can be greatly reduced, and the whole apparatus can be downsized.

[Brief Description of the Drawings]

[Fig. 1]

A schematic plan view showing a multi-beam scanning apparatus of an embodiment.

[Fig. 2]

An enlarged perspective view showing a multi-beam semiconductor laser of the apparatus in Fig. 1.

[Fig. 3]

Views for explaining line interval adjustment.

[Fig. 4]

A perspective view showing a laser holder temporarily fixed to an optical box.

[Fig. 5]

A view for explaining final line interval adjustment.

[Fig. 6]

A schematic view showing a variation.

[Fig. 7]

A schematic view showing an apparatus in Fig. 6 together with a laser driving circuit board;

[Fig. 8]

A schematic view showing another variation.

[Fig. 9]

A schematic plan view showing a conventional multi-beam scanning apparatus.

[Fig. 10]

Views for explaining line interval adjustment in the multi-beam scanning apparatus in Fig. 9.

[Explanation of symbols]

1 multi-beam light source unit

2 cylindrical lens

3 rotary polygon mirror

4 imaging lens

8 optical housing

11, 31, 41 multi-beam semiconductor laser

11a, 31a, 41a laser holder

11b screw

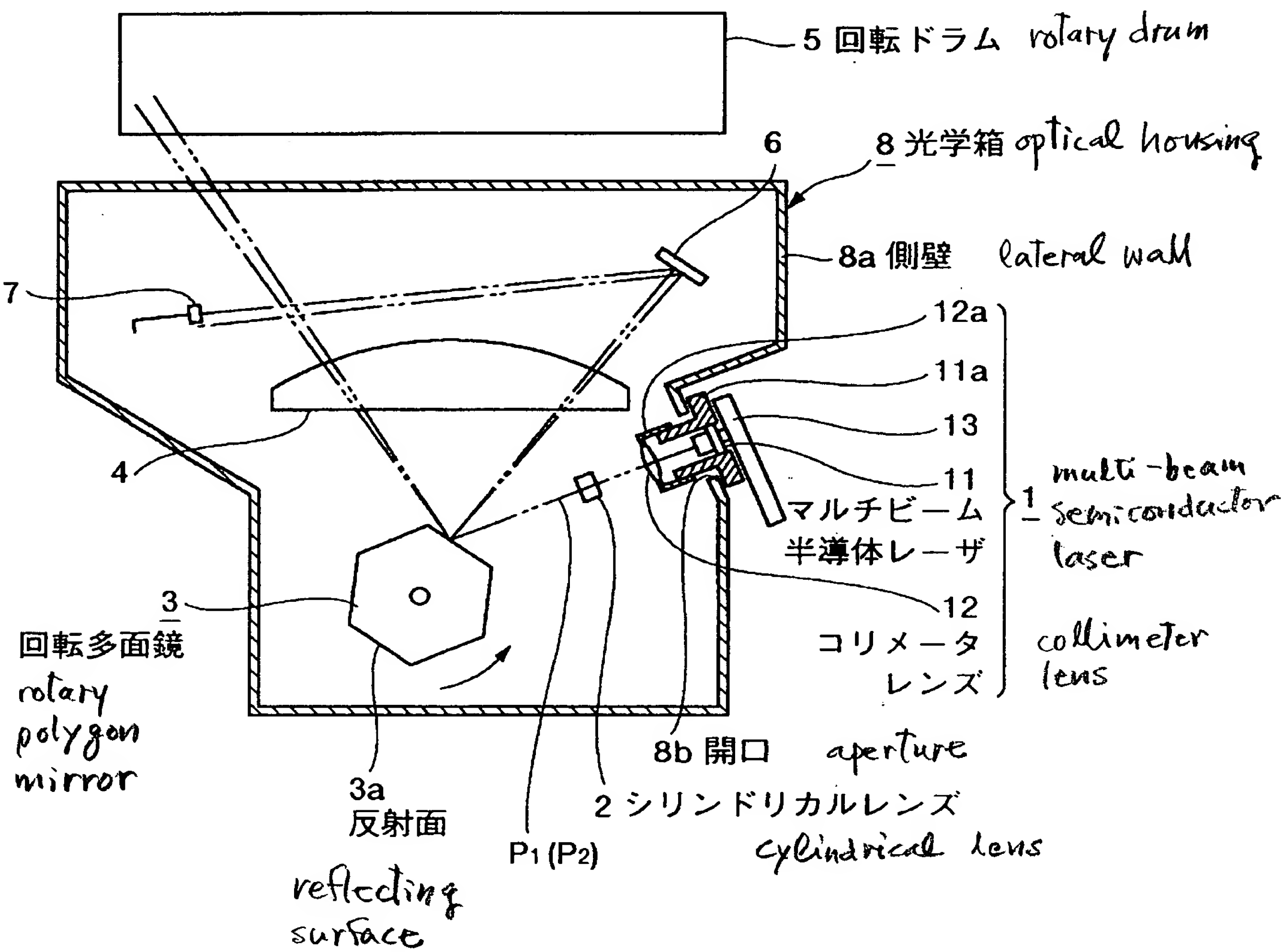
12 collimeter lens

12a lens barrel

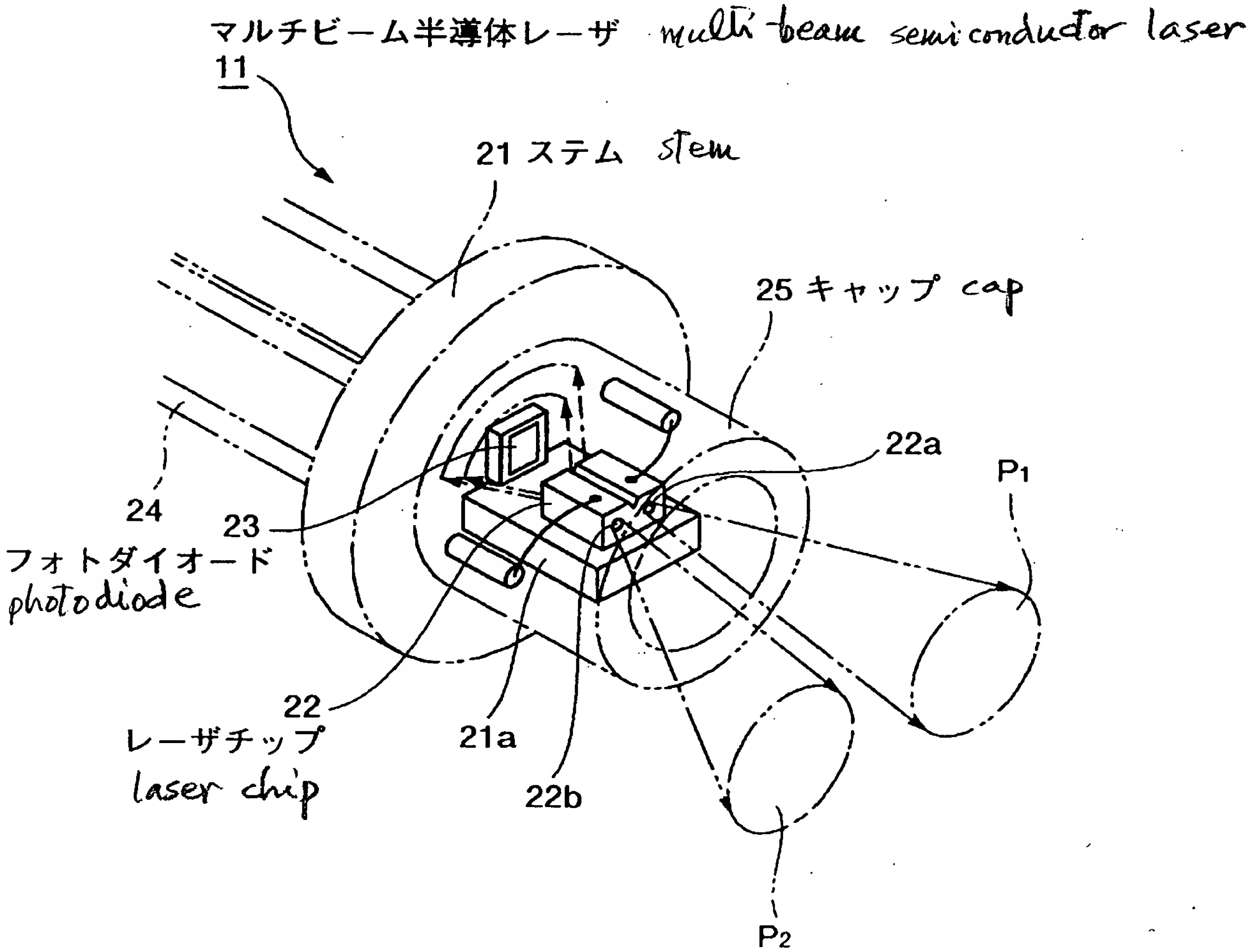
13, 33 laser driving circuit board

【書類名】 図面 [Name of the Document] Drawings

【図１】 [Fig. 1]

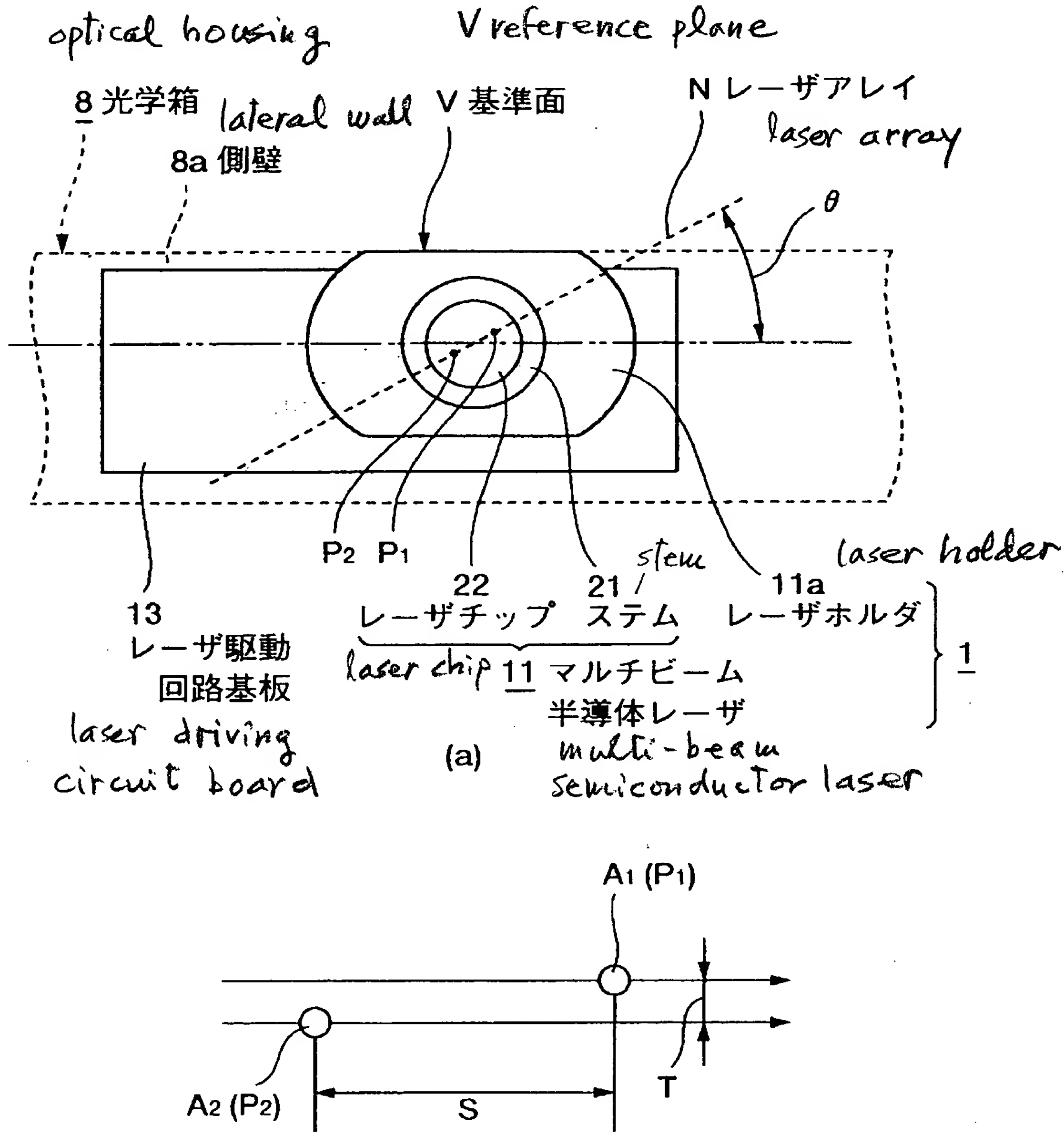


【図２】 [Fig. 2]

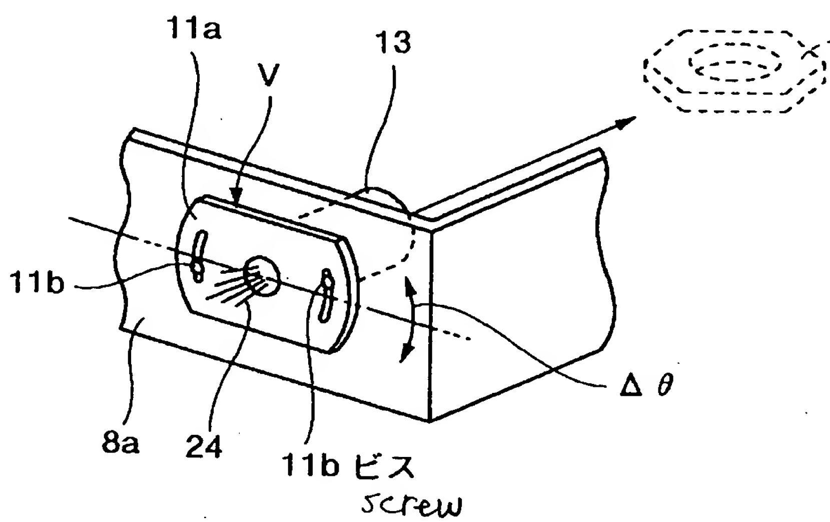


マルチビーム半導体レーザ multi-beam semiconductor laser
11
21 ステム stem
25 キャップ cap
22a
P1
24
23
フォトダイオード
photodiode
22
レーザチップ
laser chip
21a
22b
P2

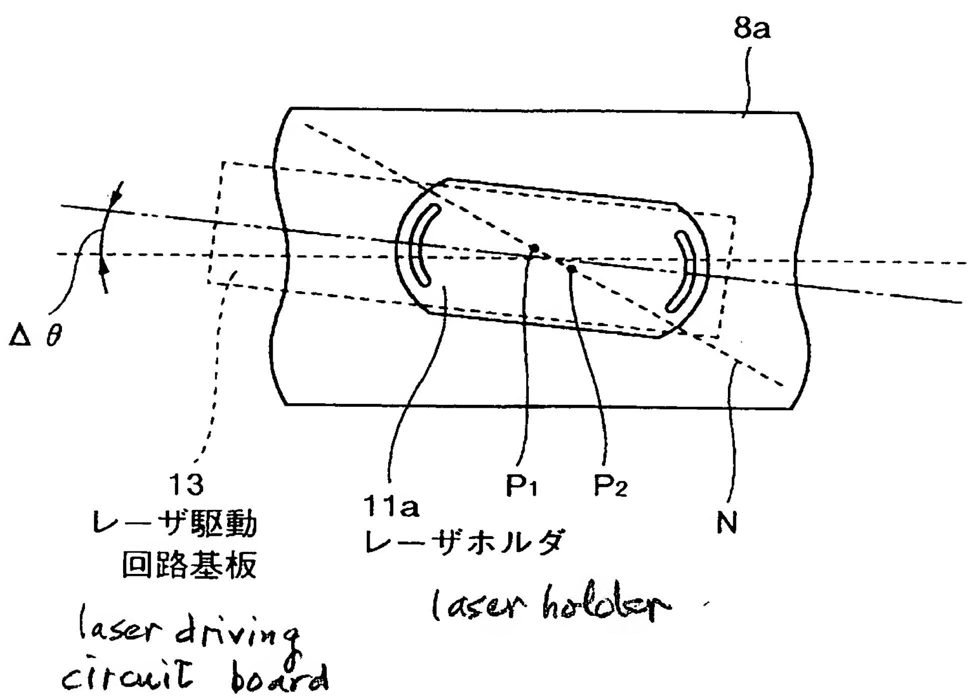
【図３】 [Fig. 3]


optical housing
V reference plane
8 光学箱
lateral wall
V 基準面
N レーザアレイ
laser array
8a 側壁
θ
P2 P1
stem
laser holder
22
レーザチップ
21
ステム
11a
レーザホルダ
13
レーザ駆動
回路基板
laser chip
11 マルチビーム
半導体レーザ
1
laser driving
circuit board
(a)
multi-beam
semiconductor laser
A1 (P1)
A2 (P2)
S
T
(b)

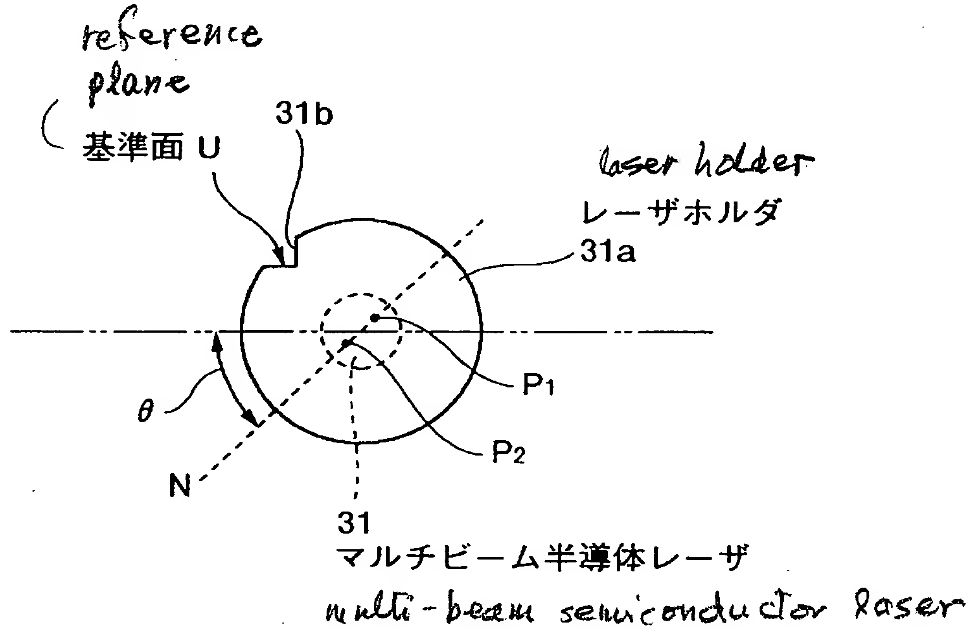
【図４】 [Fig.4]



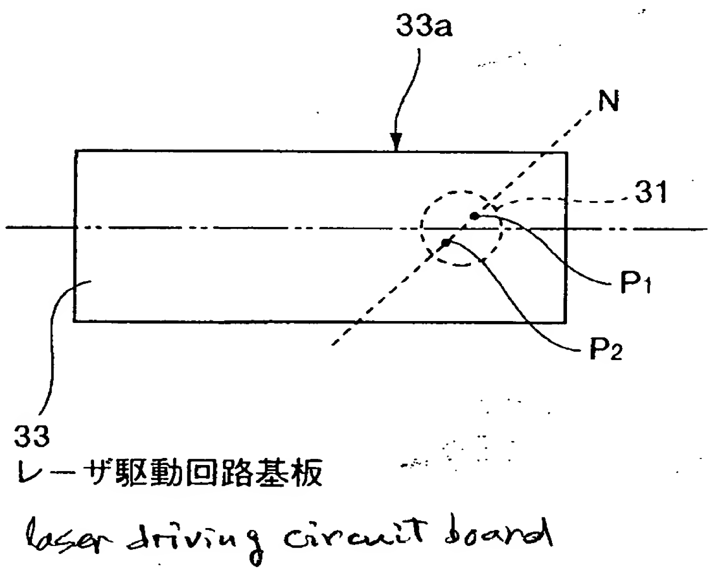
【図５】 [Fig.5]



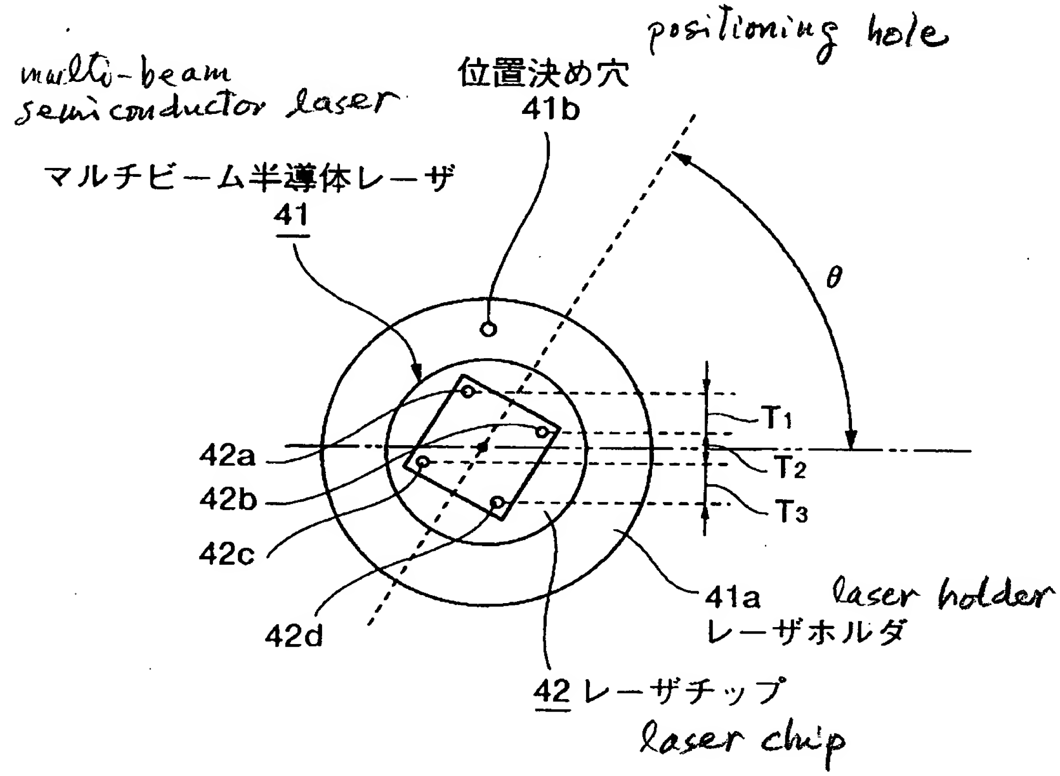
【図６】 [Fig. 6]



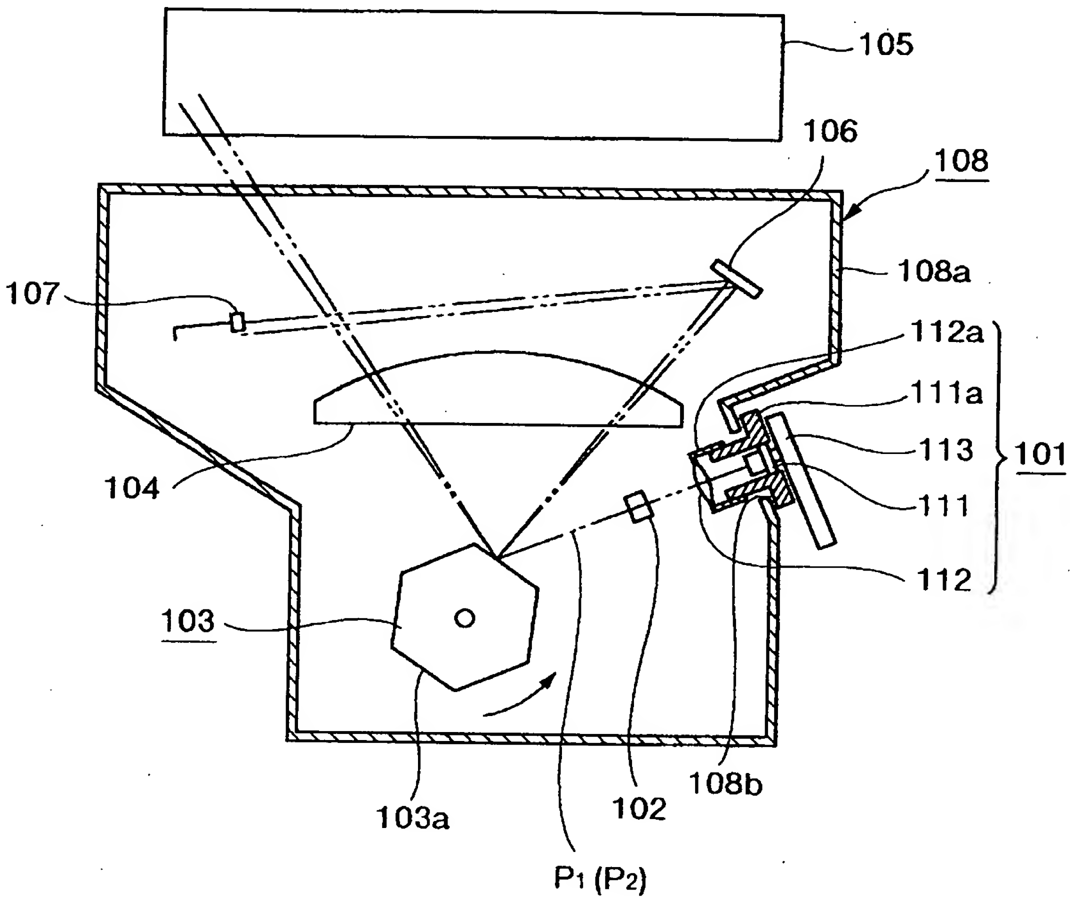
【図７】 [Fig. 7]



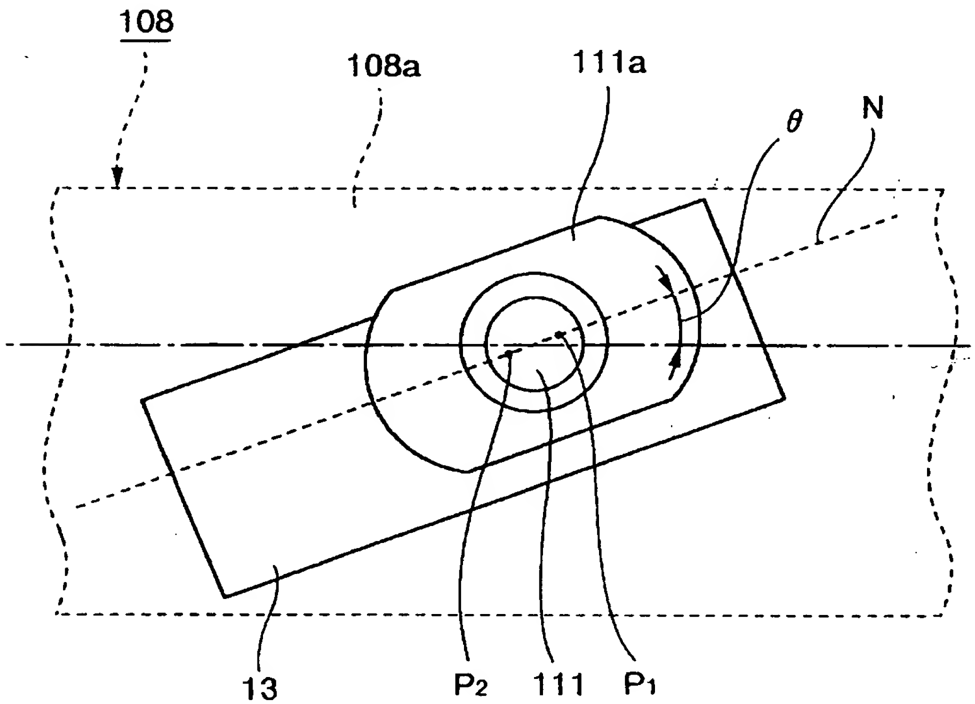
【図８】 [Fig. 8]


positioning hole
位置決め穴
41b
multi-beam semiconductor laser
マルチビーム半導体レーザ
41
θ
T1
T2
T3
42a
42b
42c
42d
41a laser holder
レーザホルダ
42 レーザチップ
laser chip

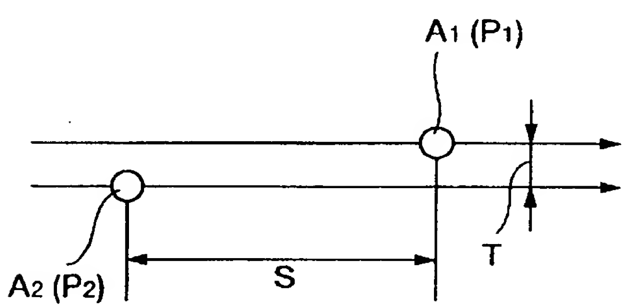
【図９】 [Fig. 9]


105
106
108
108a
107
112a
111a
113
101
104
111
112
103
103a
102
108b
P1 (P2)

【図１０】 [Fig. 10]



(a)



(b)